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(54) **LOVE LATENCY CONTENT PRESENTATION**

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H04L 29/06	(2006.01)
G06F 21/80	(2013.01)
G06F 21/10	(2013.01)

(52) **U.S. Cl.**
CPC ***H04L 63/0457*** (2013.01); ***G06F 21/80*** (2013.01); *G06F 21/10* (2013.01)

(58) **Field of Classification Search**
CPC G06F 21/10; H04L 29/06476; H04N 21/23473; H04N 21/23476
USPC 726/26
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,640,435	B2 *	12/2009	Morten	713/189
7,802,277	B2 *	9/2010	Medford	725/25
8,280,051	B2 *	10/2012	Malcolm et al.	380/212
8,700,897	B2 *	4/2014	Peng et al.	713/165
2014/0052873	A1 *	2/2014	Watson et al.	709/231

* cited by examiner

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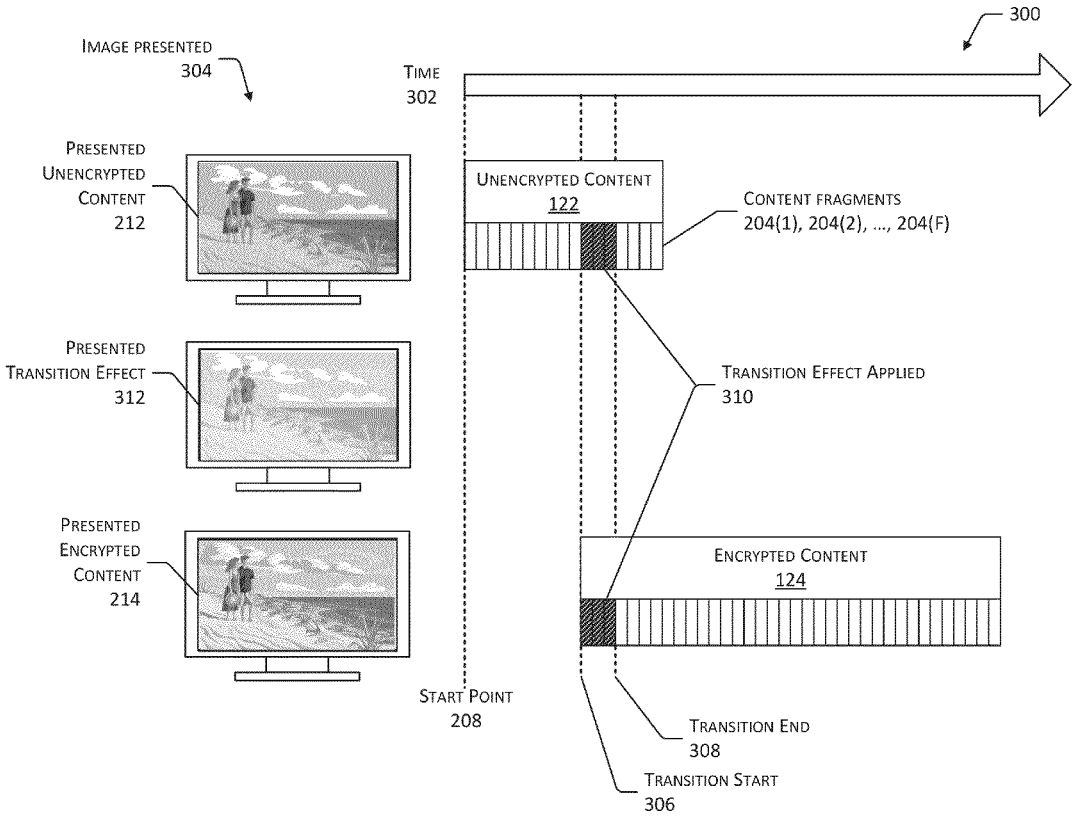
(57) **ABSTRACT**

Described herein are systems and methods for initiating presentation of content on a device. Unencrypted content is received for presentation. During presentation of the unencrypted content, encrypted content is accessed, decrypted and prepared for presentation. Once available, the presentation transitions from the unencrypted content to the encrypted content. As a result, latencies involved in accessing the encrypted content do not affect presentation to a user.

24 Claims, 9 Drawing Sheets



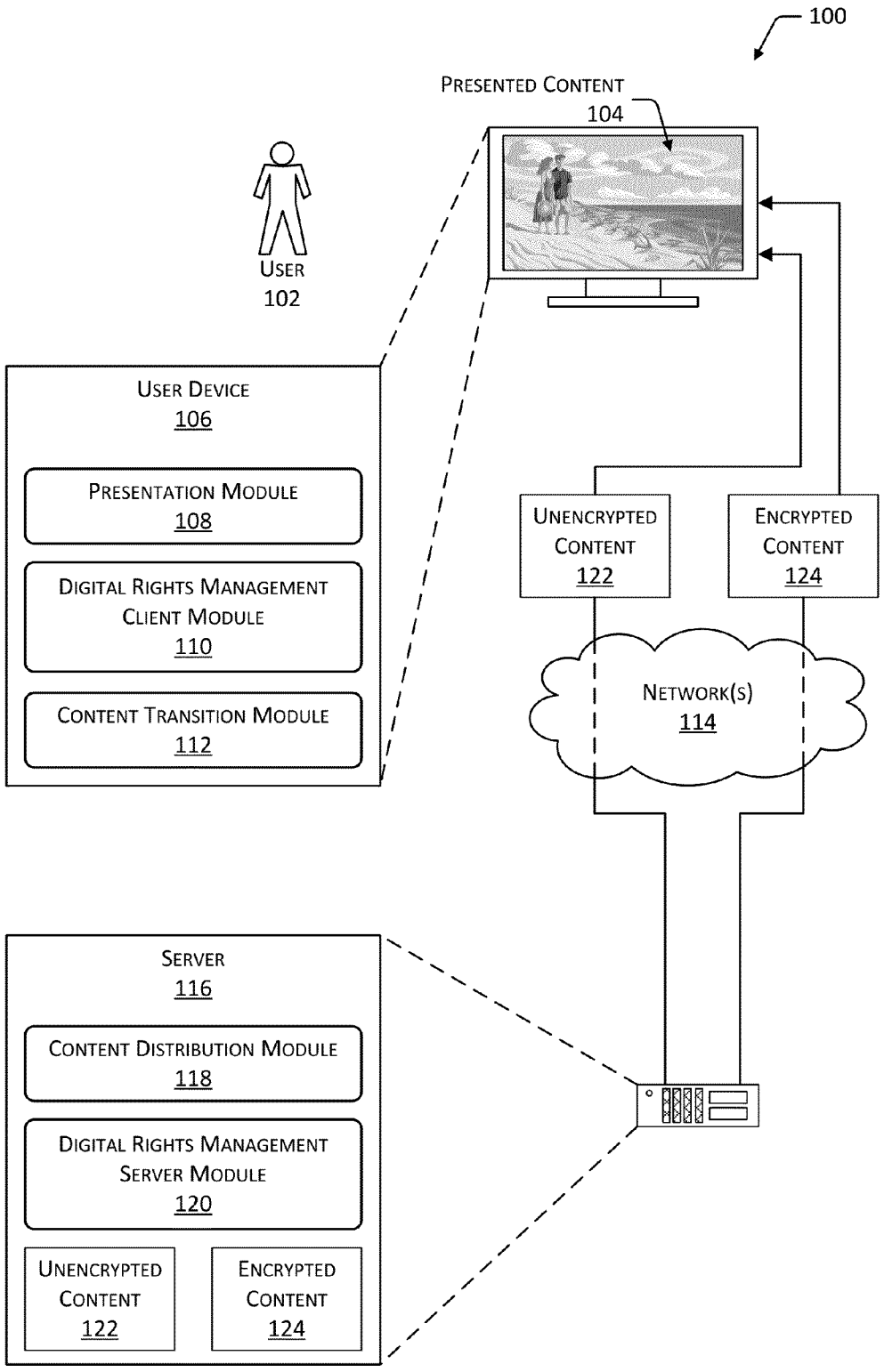

100
PRESENTED CONTENT
104
USER
102
USER DEVICE
106
PRESENTATION MODULE
108
DIGITAL RIGHTS MANAGEMENT CLIENT MODULE
110
CONTENT TRANSITION MODULE
112
UNENCRYPTED CONTENT
122
ENCRYPTED CONTENT
124
NETWORK(S)
114
SERVER
116
CONTENT DISTRIBUTION MODULE
118
DIGITAL RIGHTS MANAGEMENT SERVER MODULE
120
UNENCRYPTED CONTENT
122
ENCRYPTED CONTENT
124

FIG. 1

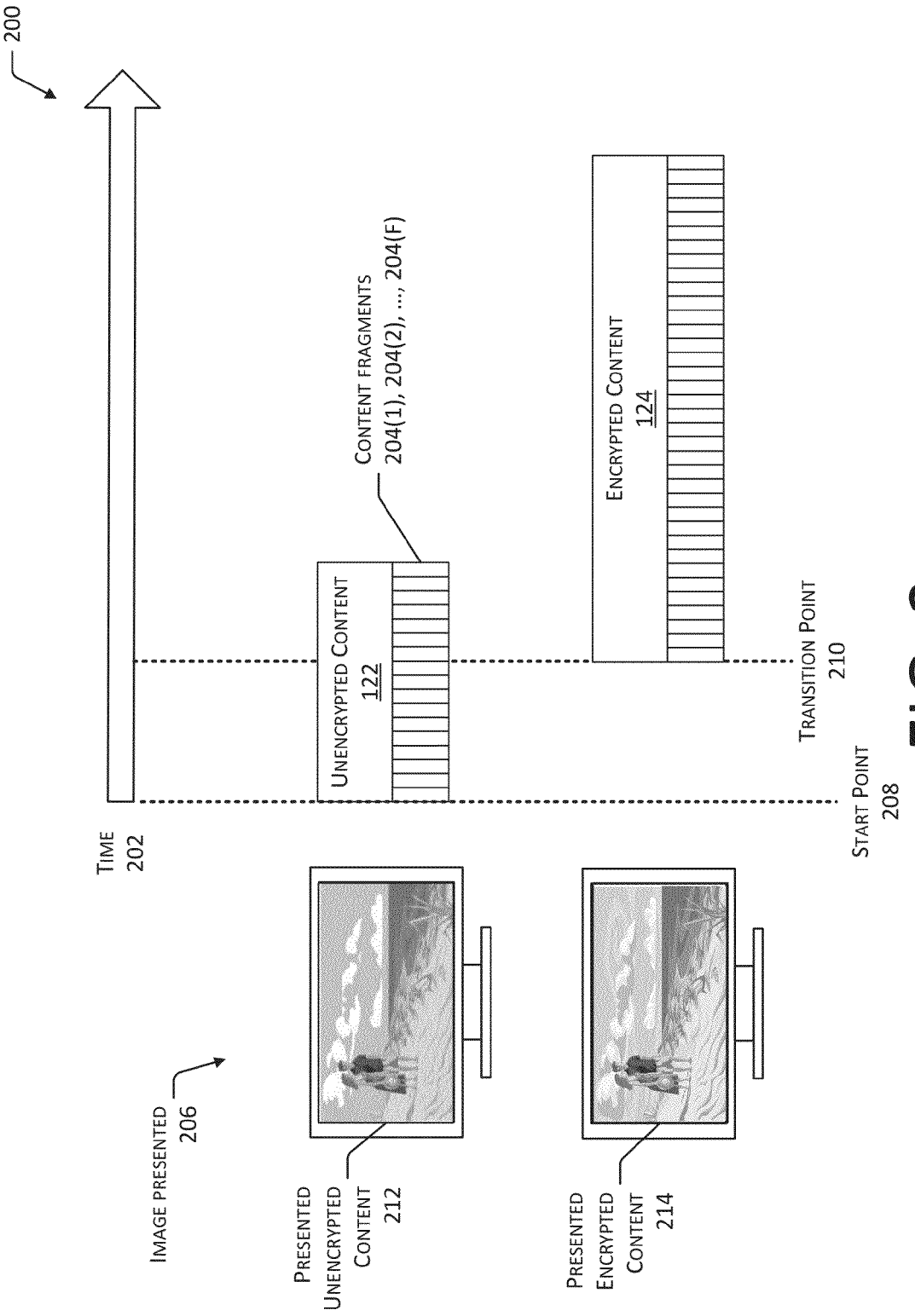

200
TIME
202
UNENCRYPTED CONTENT
122
CONTENT FRAGMENTS
204(1), 204(2), ..., 204(F)
ENCRYPTED CONTENT
124
TRANSITION POINT
210
START POINT
208
IMAGE PRESENTED
206
PRESENTED UNENCRYPTED CONTENT
212
PRESENTED ENCRYPTED CONTENT
214

FIG. 2

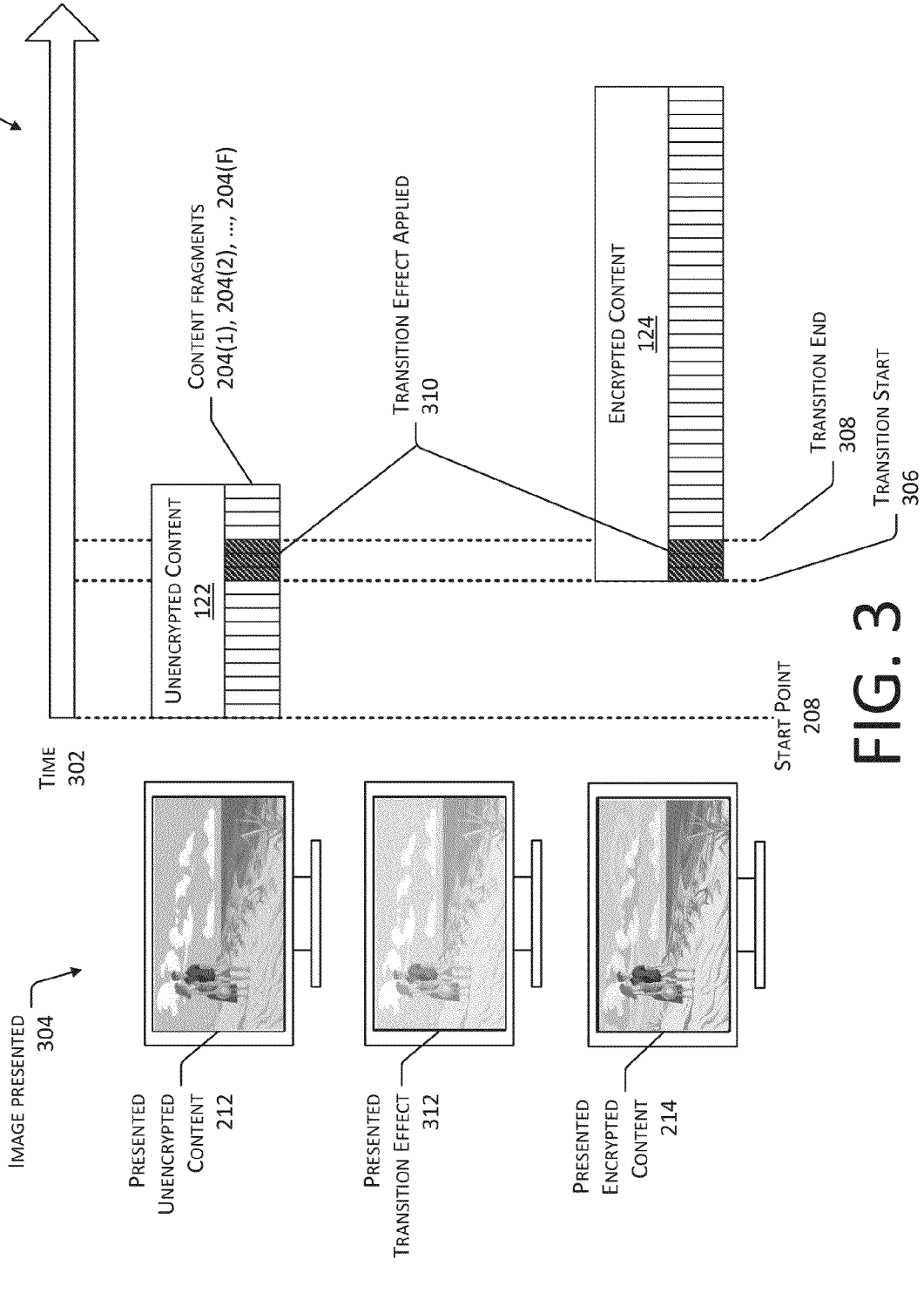

300
Content fragments
204(1), 204(2), ..., 204(F)
Transition Effect Applied
310
Encrypted Content
124
Transition End
308
Transition Start
306
Unencrypted Content
122
Start Point
208
Time
302
Image presented
304
Presented
Unencrypted
Content
212
Presented
Transition Effect
312
Presented
Encrypted
Content
214

FIG. 3

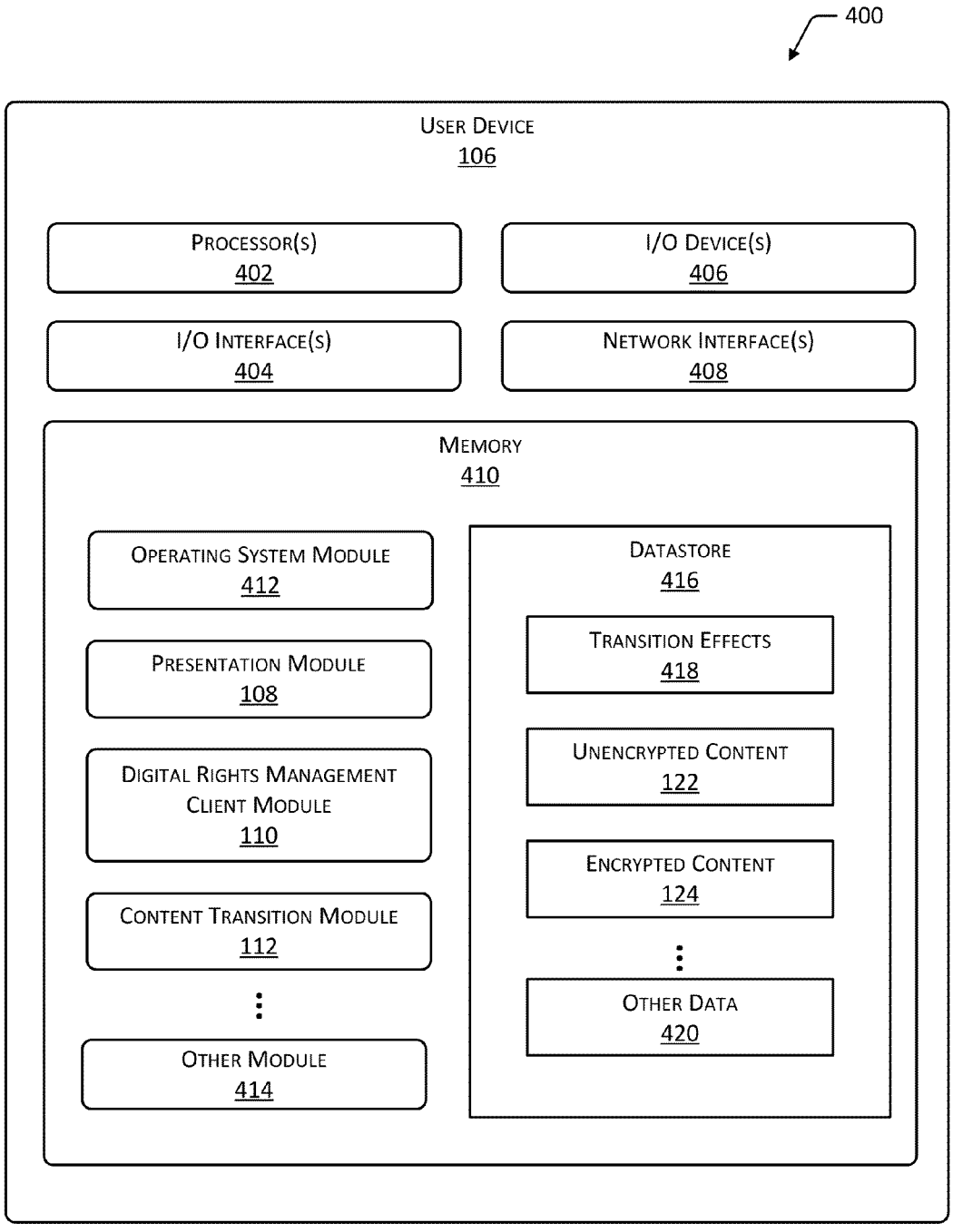

400
User Device
106
Processor(s)
402
I/O Device(s)
406
I/O Interface(s)
404
Network Interface(s)
408
Memory
410
Operating System Module
412
Presentation Module
108
Digital Rights Management Client Module
110
Content Transition Module
112
Other Module
414
Datastore
416
Transition Effects
418
Unencrypted Content
122
Encrypted Content
124
Other Data
420

FIG. 4

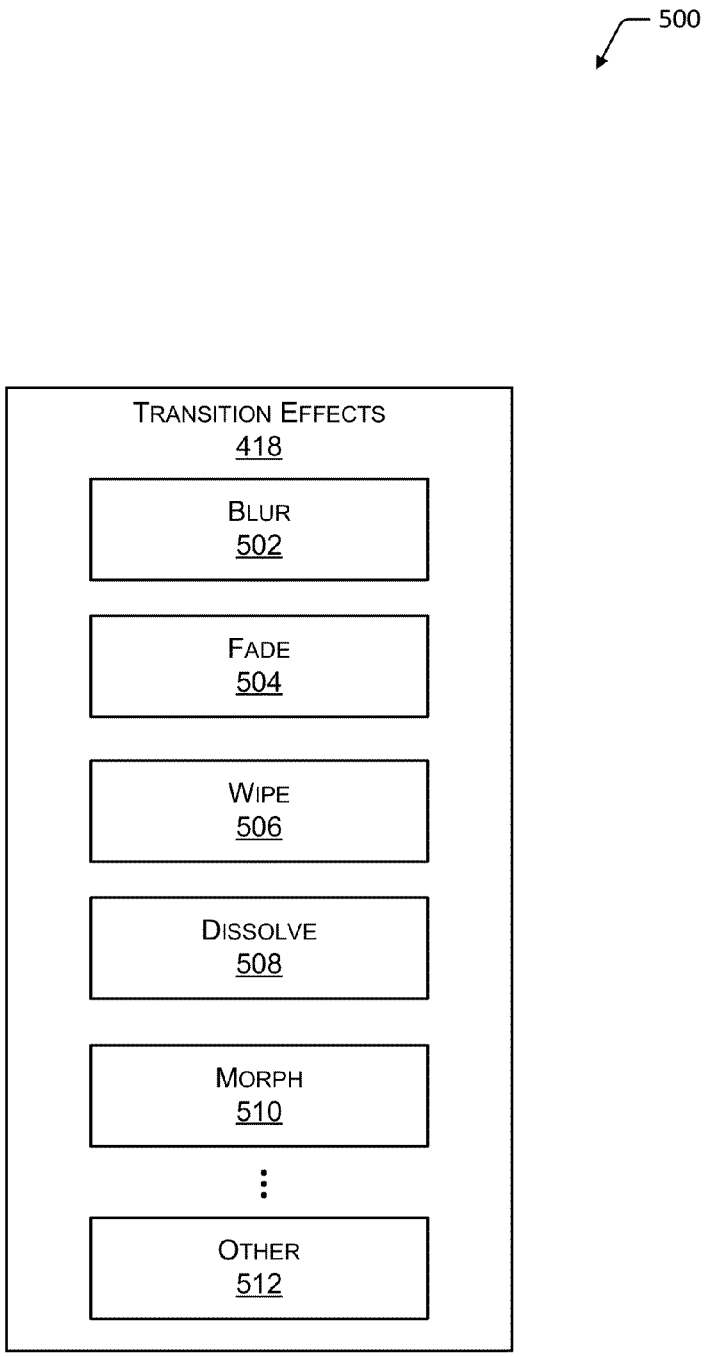

500
TRANSITION EFFECTS
418
BLUR
502
FADE
504
WIPE
506
DISSOLVE
508
MORPH
510
OTHER
512

FIG. 5

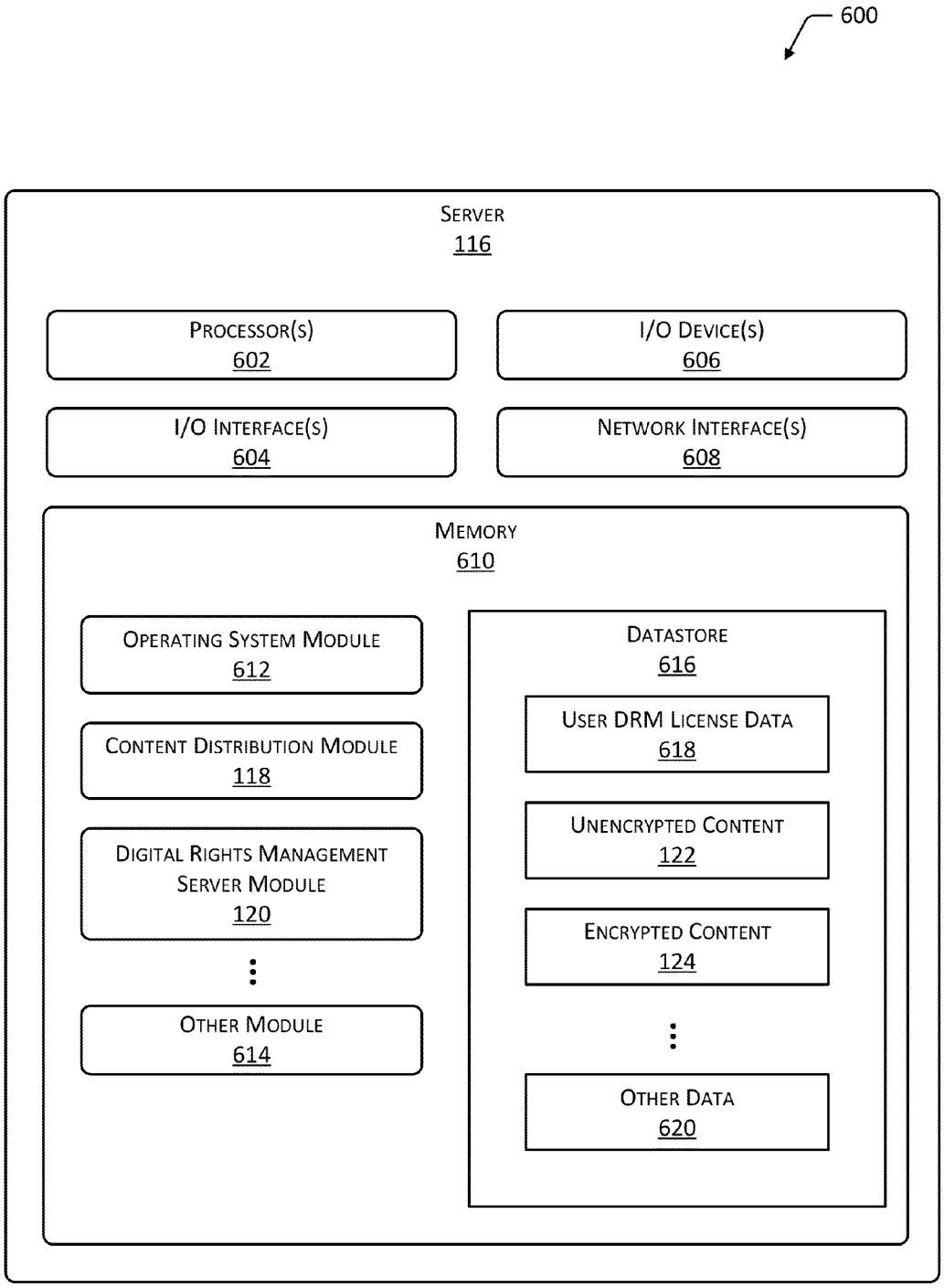

600
SERVER
116
PROCESSOR(S)
602
I/O DEVICE(S)
606
I/O INTERFACE(S)
604
NETWORK INTERFACE(S)
608
MEMORY
610
OPERATING SYSTEM MODULE
612
CONTENT DISTRIBUTION MODULE
118
DIGITAL RIGHTS MANAGEMENT SERVER MODULE
120
OTHER MODULE
614
DATASTORE
616
USER DRM LICENSE DATA
618
UNENCRYPTED CONTENT
122
ENCRYPTED CONTENT
124
OTHER DATA
620

FIG. 6

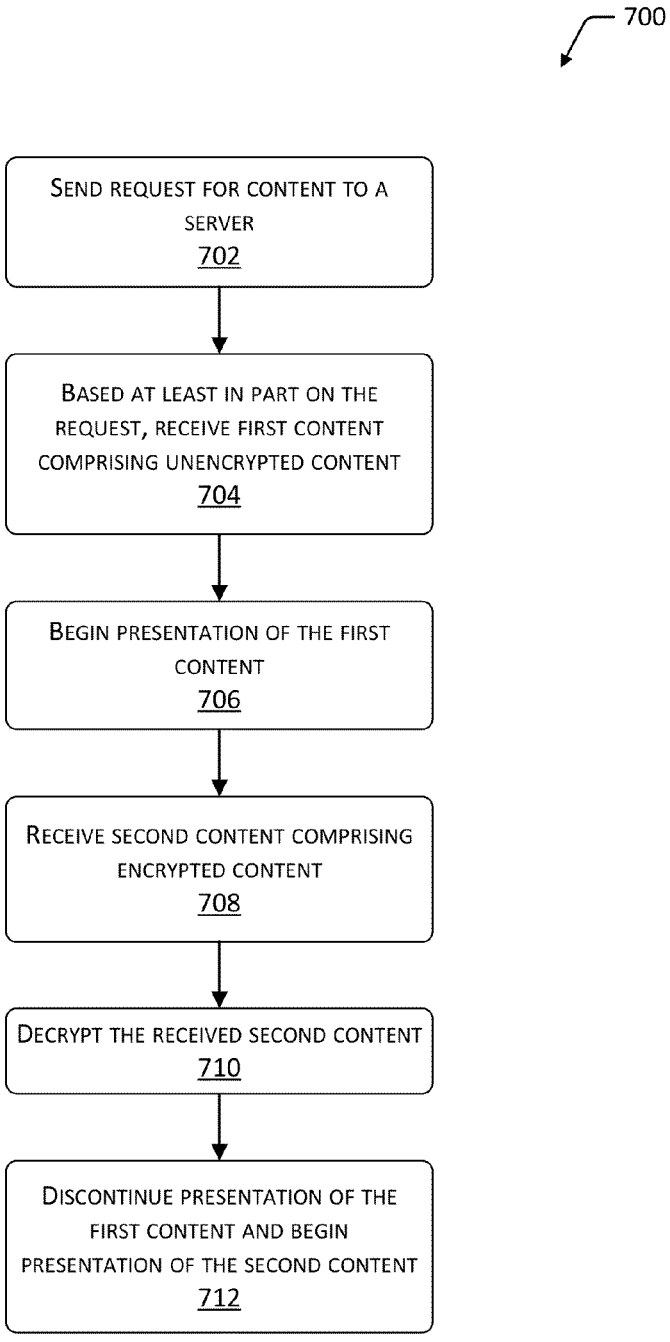

700
SEND REQUEST FOR CONTENT TO A SERVER
702
BASED AT LEAST IN PART ON THE REQUEST, RECEIVE FIRST CONTENT COMPRISING UNENCRYPTED CONTENT
704
BEGIN PRESENTATION OF THE FIRST CONTENT
706
RECEIVE SECOND CONTENT COMPRISING ENCRYPTED CONTENT
708
DECRYPT THE RECEIVED SECOND CONTENT
710
DISCONTINUE PRESENTATION OF THE FIRST CONTENT AND BEGIN PRESENTATION OF THE SECOND CONTENT
712

FIG. 7

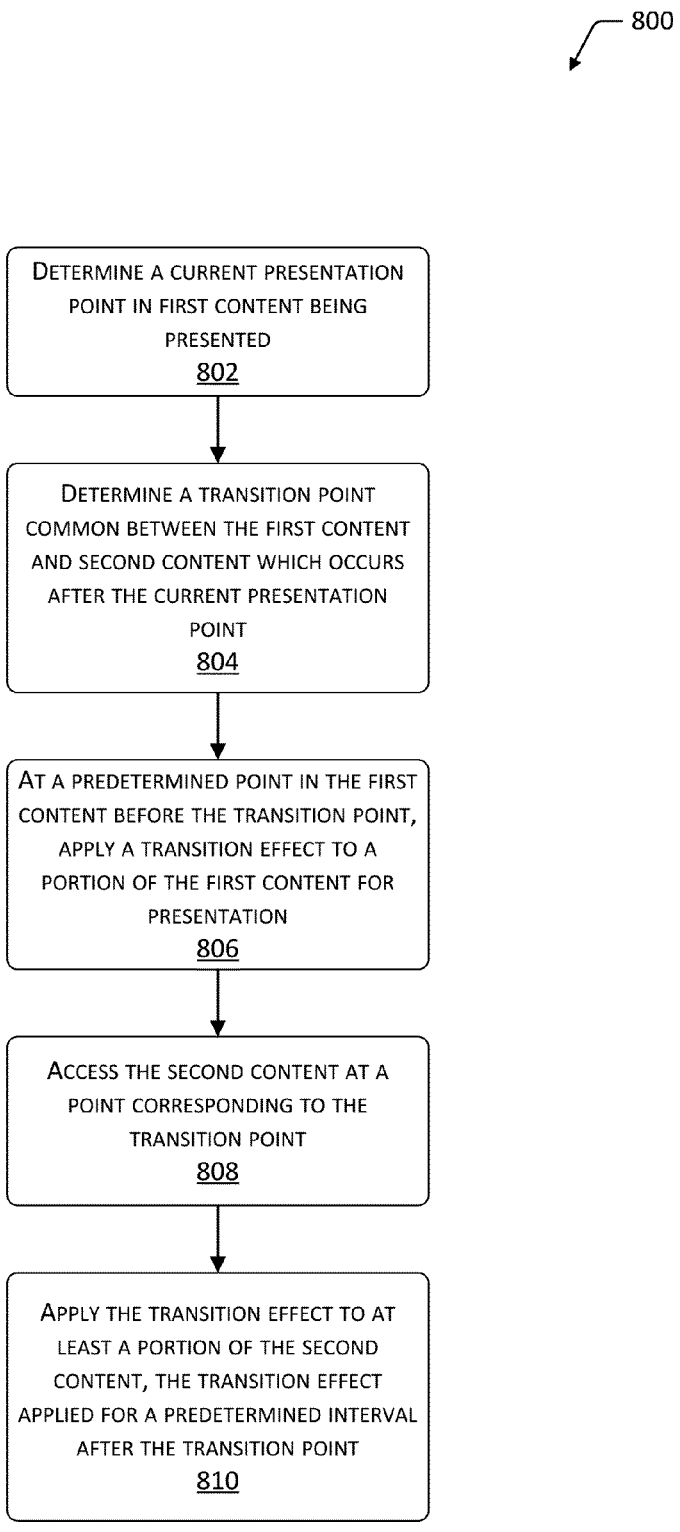

800
DETERMINE A CURRENT PRESENTATION POINT IN FIRST CONTENT BEING PRESENTED
802
DETERMINE A TRANSITION POINT COMMON BETWEEN THE FIRST CONTENT AND SECOND CONTENT WHICH OCCURS AFTER THE CURRENT PRESENTATION POINT
804
AT A PREDETERMINED POINT IN THE FIRST CONTENT BEFORE THE TRANSITION POINT, APPLY A TRANSITION EFFECT TO A PORTION OF THE FIRST CONTENT FOR PRESENTATION
806
ACCESS THE SECOND CONTENT AT A POINT CORRESPONDING TO THE TRANSITION POINT
808
APPLY THE TRANSITION EFFECT TO AT LEAST A PORTION OF THE SECOND CONTENT, THE TRANSITION EFFECT APPLIED FOR A PREDETERMINED INTERVAL AFTER THE TRANSITION POINT
810

FIG. 8

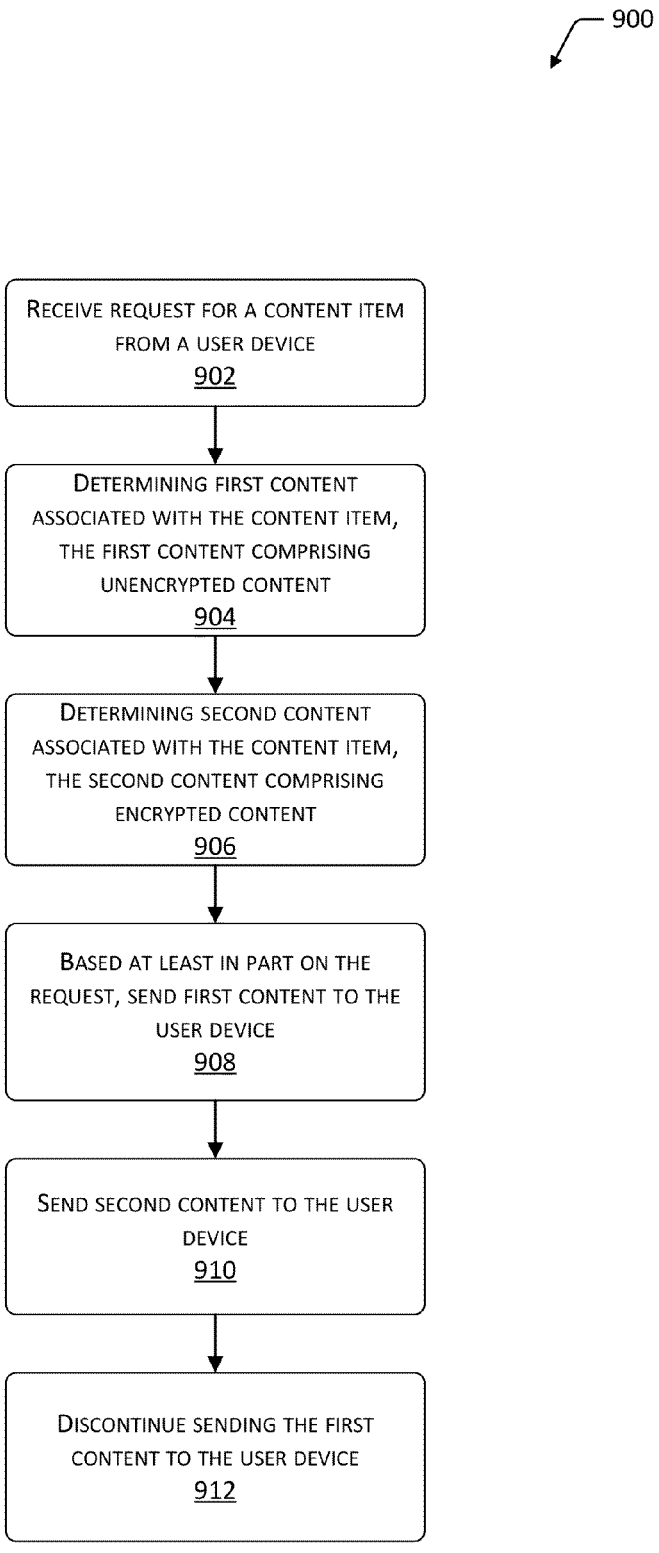

900
RECEIVE REQUEST FOR A CONTENT ITEM FROM A USER DEVICE
902
DETERMINING FIRST CONTENT ASSOCIATED WITH THE CONTENT ITEM, THE FIRST CONTENT COMPRISING UNENCRYPTED CONTENT
904
DETERMINING SECOND CONTENT ASSOCIATED WITH THE CONTENT ITEM, THE SECOND CONTENT COMPRISING ENCRYPTED CONTENT
906
BASED AT LEAST IN PART ON THE REQUEST, SEND FIRST CONTENT TO THE USER DEVICE
908
SEND SECOND CONTENT TO THE USER DEVICE
910
DISCONTINUE SENDING THE FIRST CONTENT TO THE USER DEVICE
912

FIG. 9

LOVE LATENCY CONTENT PRESENTATION

BACKGROUND

A wide variety of content is available for download or streaming from content providers. To maintain the rights of the content creators, distributors and others, the content may be protected using one or more digital rights management (DRM) schemes. DRM's protection of the content may encourage content providers to make content available for distribution online. However, implementation of DRM may result in delays to presentation of the content which are apparent to the users. For example, the user may experience about five seconds of initial delay before presentation of DRM-protected content begins. This delay may result in an unacceptable user experience.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is an illustrative system for low latency content presentation.

FIG. **2** illustrates a transition from presentation of unencrypted content to encrypted content.

FIG. **3** illustrates a transition during presentation from unencrypted content to transition content then to encrypted content.

FIG. **4** illustrates a block diagram of a user device configured to support low latency content presentation.

FIG. **5** illustrates a block diagram of transition effects which may be used to transition from the unencrypted content to the encrypted content.

FIG. **6** illustrates a block diagram of a server configured to support low latency content presentation.

FIG. **7** is a flow diagram of a process of low latency content presentation from the user device point of view.

FIG. **8** is a flow diagram of a process of transitioning from unencrypted content to encrypted content during low latency content presentation.

FIG. **9** is a flow diagram of a process of low latency content presentation from the server point of view.

Certain implementations and embodiments will now be described more fully below with reference to the accompanying figures, in which various aspects are shown. However, various aspects may be implemented in many different forms and should not be construed as limited to the implementations set forth herein. Like numbers refer to like elements throughout.

DETAILED DESCRIPTION

The collection of content available for users to access continues to grow. This content may include audio books, music, movies, television programming and so forth which may be streamed from a server over a data network such as the Internet to a user device for presentation. The user device may comprise a tablet, smartphone, set-top box, television, in-vehicle entertainment system, game console, portable computer, desktop computer and so forth. Streaming involves the ongoing transfer of data to the user device. This transfer is configured such that presentation may begin while the transfer is taking place.

The content may be protected using digital rights management ("DRM") schemes. The DRM schemes may use encryption, dedicated hardware for decryption and so forth, to control presentation of the content on the user devices. The implementation of DRM tools may encourage content creators and distributors to make the content available online.

After selecting DRM-protected content for presentation, a user may experience a prolonged period of about five seconds during which DRM is configured to allow for presentation of the content. For example, encryption keys may be exchanged, user device hardware codes retrieved and verified, and so forth. Once established, the DRM-protected content may be presented. However, the delay or latency which occurs between the selection and the actual presentation of the content may result in an undesirable user experience.

Described in this disclosure are methods and systems for providing low latency content presentation. Using a user device, the user may select a piece of content for presentation and send a request for that content to a server. The server, based at least in part on the request, sends unencrypted content to the user device for immediate presentation. Because the unencrypted content does not call for DRM controls, presentation on the user device may begin without delay. The unencrypted content may be based at least in part on the content requested. In one implementation, the unencrypted content may comprise an initial portion of the content, such as the beginning thirty seconds of the content.

While the user device receives and presents the unencrypted content, the server is providing second content which comprises the encrypted content which is subject to DRM. The user device is configured in the usual fashion to present the DRM-protected encrypted content. The user device then transitions from presenting the unencrypted content to the encrypted content. This transition may include the discontinuation of the presentation of the first content and beginning the presentation of the second content. The transition may be configured such that the transition is seamless. In some implementations, a transition effect may be applied during the transition from the first content to the second content. These transition effects may include blur, fade, wipe, and so forth.

In some implementations the first content may be encrypted using a protection scheme which is simpler and requires less time to present. For example, the first content may be encrypted using a shared key associated with the particular device. This encryption may be less stringent than that imposed by the DRM, but is able to result in presentation more swiftly than the full DRM interaction requires. Furthermore, due to the limited duration of the first content, potential compromise of this encryption scheme may not be deemed significant.

Using these techniques, during presentation of the content the user does not perceive the latencies involved in presenting DRM-protected content. As a result, the overall user experience is improved.

Illustrative System

FIG. **1** is an illustrative system **100** for low latency content presentation. A user **102** is depicted viewing presented content **104** on a user device **106**. While a single user **102** is shown, more than one user may consume content at a given time, such as where multiple users are watching the presented content **104** together. The user device **106** may include a tablet, smartphone, set-top box, television, in-vehicle entertainment system, game console, portable computer, desktop computer and so forth.

The user device **106** may include a presentation module **108** configured to request and present streamed content on one or more output devices. Streaming is an ongoing transfer of data to the user device, the transfer configured such that presentation may begin while the transfer is taking place. The output devices may include a display, a sound system, a haptic output device and so forth. A digital rights management ("DRM") client module **110** is configured to receive and decrypt content which is encoded using one or more DRM

schemes. A content transition module **112** is configured to facilitate transition from unencrypted to encrypted content. The user device **106** is discussed below in more detail with regard to FIG. **4**

The user device **106** may couple to one or more networks **114**. The one or more networks **114** may include one or more public networks such as the Internet, private networks, or a combination of both, which are configured to transfer data between devices. The network **114** in turn couples to a server **116**. While a single server **116** is depicted, in some implementations the server **116** or the functions attributed to the server **116** may be provided by a plurality of devices, such as where the server **116** is a virtualized server executing across a plurality of physical servers.

The server **116** may include a content distribution module **118**, a digital rights management server module **120**, unencrypted content **122** and encrypted content **124**. The content distribution module **118** is configured to provide the unencrypted content **122** and the encrypted content **124** to the user device **106**. In some implementations, operation of the content distribution module **118** may be based at least in part on the server **116** receiving a request from the user device **106** to stream a piece of content.

In some implementations the unencrypted content **122** and the encrypted content **124** may be provided by different servers **116**. These different servers **116** may be operated by different entities.

The DRM server module **120** is configured to apply one or more DRM schemes to generate the encrypted content **124**. In some implementations the encrypted content **124** may be encrypted prior to storage on the server **116**, may be encrypted on demand, or may use a combination of both. The server **116** is discussed in more detail below with regard to FIG. **6**.

The unencrypted content **122** and the encrypted content **124** may be based at least in part on the same piece of content, or the unencrypted content **122** may be based at least in part on the encrypted content **124**. For example, the content may comprise the movie "Burnt Sage," from which the unencrypted content **122** and the encrypted content **124** are generated. The unencrypted content **122** and the encrypted content **124** are thus associated with a common content item.

The unencrypted content **122** is content to which the DRM schemes are not applied. The unencrypted content **122** is configured for presentation on the user device **106** without undue delay or various user device-server interactions. The unencrypted content **122** may be limited in duration, resolution, or both. The unencrypted content **122** may thus have a total overall length or duration which, when presented, is less than the encrypted content **124**. For example, the unencrypted content **122** may have a total length of thirty seconds, while the encrypted content **124** has a total length of ninety minutes. In another implementation, the unencrypted content **122** may be at a lower resolution than the encrypted content **124**.

The encrypted content **124** comprises content to which the DRM schemes are applied. Presentation of the encrypted content **124** may require device validation, decryption and so forth.

The unencrypted content **122** and the encrypted content **124** may be associated with the same piece of content, or otherwise associated with one another. In one implementation a piece of content may be encrypted to generate the encrypted content **124**, while a portion of the piece of content may be used to generate the unencrypted content **122**. In another implementation, the encrypted content **124** may be accessed and a portion of the encrypted content **124** may be decrypted to form the unencrypted content **122**.

In another implementation, the unencrypted content **122** may be other content associated with the encrypted content **124**. For example, the unencrypted content **122** may comprise a studio introduction clip corresponding to the studio which produced the encrypted content **124**.

The content distribution module **118** is configured to provide the unencrypted content **122** to the presentation module **108** of the user device **106**. The user device **106** proceeds to cause the presentation of the unencrypted content **122**. Meanwhile, the DRM client module **110** communicates with the DRM server module **120** to configure the user device **106** to present the encrypted content **124**. For example, encryption keys may be exchanged, hardware device identification confirmed and so forth.

The content transition module **112** is configured to work with the presentation module **108** to cause the discontinuation of presentation of the unencrypted content **122** and causing the presentation of the encrypted content **124**. To the user **102**, the transition may be undetected, or characterized by an increase in the resolution of the presented content **104**. Once the transition is complete, the presentation of the encrypted content **124** continues. From the perspective of the user **102**, the requested content began presentation quickly, without waiting for a lengthy DRM transaction to be completed.

FIG. **2** illustrates a transition **200** from presentation of the unencrypted content **122** to the encrypted content **124**. In this illustration, time increases to the right, as indicated by the arrow **202**. Depicted is the unencrypted content **122**, which comprises one or more content fragments **204**(**1**), **204**(**2**), . . . , **204**(F). The fragments **204** may comprise individual frames or groups of frames. In some implementations the fragments **204** may comprise sections of content which are about 2 seconds in duration.

Also shown here is the image presented **206** by the user device **106** at various points. The unencrypted content **122** starts presentation at a start point **208**, such as time zero, until a transition point **210**. As shown here, presented unencrypted content **212** is presented by the user device **106** until the transition point **210** is reached.

At the transition point **210**, the presentation of the user device **106** changes to presented encrypted content **214**. The unencrypted content **122**, no longer used for presentation, may be discarded or discontinued, while the presented encrypted content **214** continues. In some implementations, the encrypted content **124** as processed by the DRM client module **110** is used to generate the presented encrypted content **214**.

The transition point **210** may be configured to allow for a seamless transition between the unencrypted content **122** and the encrypted content **124**. For example, the transition point **210** may be configured to occur at a same presentation time occurring in both the unencrypted content **122** and the encrypted content **124**. For example, the transition point **210** may take place at an elapsed presentation time of six seconds into the content.

The transition point **210** may be predetermined and statically set. For example, a system engineer may determine that DRM configuration will be complete for presentation within five seconds and the transition point **210** may be set at six seconds to provide for additional variance. In another implementation, the transition point **210** may be determined based at least in part on the availability of the encrypted content **124** for presentation. For example, the transition point **210** may be based at least in part on when the encrypted content **124** is available for presentation, such that the transition point **210** may vary, such as from three seconds to fifteen seconds.

FIG. **3** illustrates a transition **300** during presentation from unencrypted content **122** to the encrypted content **124** using a transition effect. As above, in this illustration time increases to the right, as indicated by the arrow **302**. Depicted is the unencrypted content **122**, which comprises one or more content fragments **204**(**1**), **204**(**2**), . . . , **204**(F). Also depicted is an image presented **304** by the user device **106**.

As shown here, the unencrypted content **122** starts presentation at the start point **208**, such as time zero. As shown here, the presented unencrypted content **212** is shown by the user device **106** until a transition start **306**.

From the transition start **306** until the transition end **308**, one or more transition effects may be applied **310** to the unencrypted content **122**, the encrypted content **124**, or both. The transition effects may include blur, fade, wipe and so forth and are discussed below in more detail with regard to FIG. **5**. The application of the transition effect may minimize the user's **102** perception of an abrupt and potentially disquieting change. In another implementation, transition content may be inserted and presented between the unencrypted content **122** and the encrypted content **124**.

In this illustration the transition start **306** and the transition end **308** are depicted as occurring within the time when content fragments **204** for the unencrypted content **122** are available. During this time from the transition start **306** and the transition end **308** a presented transition effect **312** is presented by the user device **106**. In some implementations the unencrypted content **122** may cease and the encrypted content **124** may be presented, such that there is no overlap between the unencrypted content **122** and the encrypted content **124**.

The transition from the unencrypted content **122** to the encrypted content **124** may be synchronized such that the transition point **210** or the transition start **306** and the transition end **308** correspond to the same presentation time in the unencrypted content **122** and the encrypted content **124**. For example, the transition start **306** may begin at time 0:04 in the unencrypted content **122** and in the encrypted content **124**.

In some implementations, such as where the transition point **210** or the transition start **306** and the transition end **308** are pre-determined, the encrypted content **124** may be configured to begin presentation at that point. For example, the transition point **210** may be predetermined to be at six seconds. As a result, the encrypted content **124** may be configured to be delivered for presentation at a presentation time of six seconds. The encrypted content **124** may be ready to begin presentation at that particular time and the unencrypted content **122** may be transitioned to the encrypted content **124** at that five second mark.

FIG. **4** illustrates a block diagram **400** of the user device **106** configured to support low latency content presentation. The user device **106** may include one or more processors **402** configured to execute one or more stored instructions. The processors **402** may comprise one or more cores. The user device **106** may include one or more input/output ("I/O") interface(s) **404** to allow the user device **106** to communicate with other devices. The I/O interfaces **404** may comprise inter-integrated circuit ("I2C"), serial peripheral interface bus ("SPI"), universal serial bus ("USB"), RS-232, media device interface, and so forth. The media device interface may be a High Definition Multimedia Interface ("HDMI") as promulgated by HDMI Licensing LLC, TOSLINK as promulgated by Toshiba Corp., Ethernet, analog video, analog audio, IEEE 1394 as promulgated by the Institute for Electrical and Electronics Engineers, Universal Serial Bus as promulgated by the USB Implementers Forum, Digital Visual Interface ("DVI") as promulgated by the Digital Display Working Group, video graphics array ("VGA"), DisplayPort as promulgated by the Video Electronics Standards Association ("VESA"), Intel Wireless Display ("Wi-Di"), Wi-Fi Direct, Bluetooth as promulgated by the Bluetooth Special Interest Group, ZigBee as promulgated by the ZigBee Alliance, and so forth.

The I/O interface(s) **404** may couple to one or more I/O devices **406**. The I/O device(s) **406** may include user input devices such as one or more of a keyboard, a mouse, a game controller, a touch input device, gestural input device, accelerometers, microphones and so forth. The I/O devices **406** may include output devices such as one or more of a display, a printer, audio speakers, haptic output device and so forth. In some embodiments, the I/O devices **406** may be physically incorporated with the user device **106** or may be externally placed.

The user device **106** may also include one or more network interfaces **408** configured to provide communications between the user device **106** and other networked devices. Such network interface(s) **408** may include one or more network interface controllers ("NICs") or other types of transceiver devices configured to send and receive communications over the network **114**. The user device **106** may also include one or more busses or other internal communications hardware or software that allow for the transfer of data between the various modules and components of the user device **106**.

As shown in FIG. **4**, the user device **106** includes one or more memories **410**. The memory **410** comprises one or more computer-readable storage media ("CRSM"). The CRSM may be any one or more of an electronic storage medium, a magnetic storage medium, an optical storage medium, a quantum storage medium, a mechanical computer storage medium and so forth. The memory **410** provides storage of computer readable instructions, data structures, program modules and other data for the operation of the user device **106**.

The memory **410** may include at least one operating system (OS) module **412**. The OS module **412** is configured to manage hardware resources such as the I/O interfaces **404** and provide various services to applications or modules executing on the processors **402**. Also stored in the memory **410** may be the presentation module **108**, the DRM client module **110**, the content transition module **112** and other modules **414**.

As described above, the presentation module **108** is configured to request and present content on one or more output devices coupled to the user device **106**. In some implementations the presentation module **108** may execute as multiple threads on the one or more processors **402**. For example, a first thread may be configured to cause presentation of the unencrypted content **122** while a second thread is configured to cause presentation of the encrypted content **124**. The presentation module **108** may be configured to present content which is streamed to the user device **106** from the server **116**, locally stored in the memory **410**, or both. The presentation module **108** may work in conjunction with the DRM client module **110** and the content transition module **112** to present unencrypted content **122** until the encrypted content **124** is available for presentation. The content transition module **112** described below may coordinate the change in presentation from the unencrypted content **122** to the encrypted content **124**.

The DRM client module **110** is configured to receive and decrypt the encrypted content **124** which is encoded and otherwise protected using one or more DRM schemes. The DRM client module **110** may access one or more pieces of dedicated DRM hardware which are incorporated into the

user device **106**, such as a hardware decryption circuitry coupled to the processor **402**. The DRM client module **110** may send information to the server **116** indicative of the particular identity of the user device **106** and otherwise interact with the server **116** to establish an exchange of information and presentation of that information which is protected by the DRM scheme. The DRM client module **110** may be configured to decrypt the encrypted content **124** such that it may be processed by the presentation module **108** for output. As described above, the setup and verification of the DRM associated with the encrypted content **124** may take some time to complete. In some implementations, the DRM interchange may take about five seconds to complete from initial request to availability of decrypted content from the encrypted content **124**.

The content transition module **112** may also be stored in the memory **410** of the user device **106**. The content transition module **112** is configured to facilitate transition from unencrypted content **122** to encrypted content **124**. The content transition module **112** may be configured to use a static or predetermined transition point **210** such as described above with regard to FIG. **2**. For example, the transition point **210** may be specified at five seconds. In another implementation, the transition point **210** may be determined dynamically, such as relative to the availability of encrypted content **124** for presentation. For example, the transition point **210** may vary such that when the DRM scheme is implemented more quickly such as at four seconds or more slowly at seven seconds, the transition point **210** corresponds to four or seven seconds. The transition point **210** may be specified globally, for particular groups of content, may be varied according to content provider, or be specified for individual pieces of content. For example, the transition point **210** for television programs may be static at five seconds while the transition point **210** for movies may be static at seven seconds.

As described above with regard to FIG. **3**, in some implementations the content transition module **112** may apply a transition effect to a portion of the unencrypted content **122**, the encrypted content **124**, or both. For example, the content transition module **112** may apply a "dissolve" transition effect at the point where the presentation of the unencrypted content **122** gives way to the presentation of the encrypted content **124**.

Other modules **414** may be stored in the memory **410**. For example, a user interface module may be configured to provide a user interface to the user **102** and accept inputs responsive to that user interface.

The memory **410** may also include a datastore **416** to store information. The datastore **416** may use a flat file, database, linked list, tree, or other data structure to store the information. In some implementations, the datastore **416** or a portion of the datastore **416** may be distributed across one or more other devices including servers, network attached storage devices and so forth.

The datastore **416** may store information about one or more transition effects **418**. The transition effects **418** may include instructions which, when executed by the processor **402**, modify the presentation of content. The transition effects **418** are discussed in more detail below with regard to FIG. **5**.

The datastore **416** may also store the unencrypted content **122** or a portion thereof, the encrypted content **124** or a portion thereof, or both. In some implementations the content for presentation may be stored locally, such as in the datastore **416**. However, that locally stored content may still require establishment of a DRM session to allow for presentation of the content. For example, the user **102** may have downloaded using the network interface **408** a movie to the local device, but that movie may have been delivered as encrypted content **124** subject to a DRM scheme.

The unencrypted content **122**, as described above is associated with the encrypted content **124**. For example, the unencrypted content **122** and the encrypted content **124** may be for the same content item. Content items include particular titles, Identification numbers, and so forth. As described above, the unencrypted content **122** is of a shorter duration than the encrypted content **124**. In one implementation the unencrypted content **122** may comprise the initial ten seconds, or other predetermined interval, of presentation of content. The unencrypted content **122** and the encrypted content **124** may encode information at different resolutions or fidelity. For example, the unencrypted content **122** may be encoded at standard definition 480p while the encrypted content **124** is encoded at high definition 1080p.

Other data **420** may be stored in the datastore **416**. For example, user preferences as to transition effects, account access information for the DRM client module **110** and so forth.

FIG. **5** illustrates a block diagram **500** of the transition effects **418** which may be used to transition from the unencrypted content **122** to the encrypted content **124**. The content transition module **112** may segue from the unencrypted content **122** to the encrypted content **124** without applying the transition effect **418**. However, in some implementations application of the transition effect **418** may improve the user experience by mitigating what may be an otherwise abrupt transition, such as from a lower resolution to a higher one. As described above with regard to FIGS. **3** and **4**, the transition effects **418** may be applied to presented content **104** from a transition start **306** to a transition end **308** time.

The transition effects **418** may include instructions which, when executed by the processor **402**, modify the presentation of content. This may be unencrypted content **122**, encrypted content **124**, or both. The transition effects **418** may be expressed as instructions or algorithms which modify the data for presentation. The transition effects **418** may be applied to audio, video, or both. For convenience and not by way of limitation, the following transition effects **418** are described with respect to visual content such as video or still images.

A blur transition effect **502** may be provided which introduces a slight blurring to the presented content **104** before removing the blur. A fade **504** effect may gradually modify the image such that it starts or ends with a particular color such as black or white. A wipe **506** effect replaces one image with another traveling from one side of a frame to another. A dissolve **508** effect gradually changes from one image to another over time. A morph **510** may be used to reshape or readjust objects from one image to another. Other effects **512** may also be used as well.

As described above, the content transition module **112** may use the transition effects **418** to change from presenting the unencrypted content **122** to the encrypted content **124**. The transition effect **418** may be applied to a portion of the unencrypted content **122**, the encrypted content **124**, or both.

FIG. **6** illustrates a block diagram **600** of the server **116** configured to support low latency content presentation. The server **116** may include one or more processors **602** configured to execute one or more stored instructions. The processors **602** may comprise one or more cores. The server **116** may include one or more I/O interface(s) **604** to allow the server **116** to communicate with other devices. The I/O interfaces **604** may comprise I2C, SPI, USB, RS-232 and so forth.

The I/O interface(s) **604** may couple to one or more I/O devices **606**. The I/O device(s) **606** may include user input devices such as one or more of a keyboard, a mouse and so

forth. The I/O devices **606** may include output devices such as one or more of a display, a printer and so forth. In some embodiments, the I/O devices **606** may be physically incorporated with the server **116** or may be externally placed.

The server **116** may include one or more network interfaces **608** configured to provide communications between the server **116** and other networked devices. Such network interface(s) **608** may include one or more NICs or other types of transceiver devices configured to send and receive communications over the network **114**. The server **116** may also include one or more busses or other internal communications hardware or software that allow for the transfer of data between the various modules and components of the server **116**.

As shown in FIG. **6**, the server **116** includes one or more memories **610**. The memory **610** comprises one or more CRSM, such as described above. The memory **610** provides storage of computer readable instructions, data structures, program modules and other data for the operation of the server **116**.

The memory **610** may include at least one operating system (OS) module **612**. The OS module **612** is configured to manage hardware resources such as the I/O interfaces **604** and provide various services to applications or modules executing on the processors **602**. Also stored in the memory **610** may be the content distribution module **118**, the DRM server module **120** and other modules **614**.

The content distribution module **118** is configured to provide content to the user device **106**. The content distribution module **118** may receive a request or "pull" from the user device **106**, or may be configured to "push" content to the user device **106**. The content distribution module **118** may provide the unencrypted content **122**, the encrypted content **124**, or both to the user device **106**. The content distribution module **118** may be configured to determine the unencrypted content **122** which is associated with the encrypted content **124**. For example, the user device **106** may request the movie content "Burnt Sage." The content distribution module **118**, receiving this request, may determine that the unencrypted content **122** of the first ten seconds of "Burnt Sage" is available, as well as the entire movie "Burnt Sage" as encrypted content **124** subject to a DRM scheme. The content distribution module **118** may provide the unencrypted content **122** to the user device **106**, providing the user device **106** with content to begin presenting as soon as possible, while the DRM interchange with the user device **106** is completed. The content distribution module **118** may then provide the encrypted content **124**. In some implementations, the content distribution module **118** may send the encrypted content **124** while also sending the unencrypted content **122** contemporaneously.

The transmission of the encrypted content **124** in some implementations may be based at least in part on receiving data from the user device **106**. For example, this data may indicate that the user device **106** is ready to receive and present the encrypted content **124**. In yet another implementation, the DRM server module **120** may pass data to the content distribution module **118** indicating that the DRM session is established with the user device **106**.

The DRM server module **120** is configured to support one or more DRM schemes for the distribution and presentation of content. The DRM server module **120** may be configured to apply one or more DRM schemes to generate the encrypted content **124**, or may be configured to apply the one or more DRM schemes to allow for access to previously encrypted content **124**. The DRM server module **120** may be configured to work in conjunction with other elements of a DRM architecture, such as additional servers **116** configured to authenticate DRM credentials.

Other modules **614** may be stored in the memory **610**. For example, an accounting module may track usage of the content and generate billing.

The memory **610** may also include a datastore **616** to store information. The datastore **616** may use a flat file, database, linked list, tree, or other data structure to store the information. In some implementations, the datastore **616** or a portion of the datastore **616** may be distributed across one or more other devices including other servers, network attached storage devices and so forth.

The datastore **616** may store user DRM license data **618**. The user DRM license data **618** may indicate particular user accounts or user devices **106** which are permitted particular access to the encrypted content **124**.

The datastore **616** may also store the unencrypted content **122** or a portion thereof, the encrypted content **124** or a portion thereof, or both. In some implementations source content which is a full length version of the content may be stored. This source content may be encrypted by the DRM server module **120** prior to distribution as encrypted content **124** to the user device **106**.

In one implementation, the DRM server module **120** may work in conjunction with the content distribution module **118** to generate the unencrypted content **122** from the encrypted content **124**. For example, newly received full length encrypted content **124** for a particular content item may be received by the server **116**. The DRM server module **120** may be used to decrypt the first ten seconds of the encrypted content **124** and generate ten seconds of unencrypted content **122**. In one implementation the unencrypted content **122** may be stored for later transmission to the user device **106**.

In another implementation, the DRM server module **120** may be configured to decrypt on demand and produce the unencrypted content **122** to the user device **106**. This implementation may be used when the DRM server module **120** is configured to establish the necessary DRM permissions and generate the decrypted content for delivery as the unencrypted content **122** more quickly than the user device **106** is able to establish the DRM session for presentation. For example, the DRM server module **120** may take less than one second to verify DRM permissions and begin streaming unencrypted content **122** to the user device **106**, compared to the five seconds for the user device **106** itself to establish the DRM permissions and begin presentation.

Illustrative Processes

FIG. **7** is a flow diagram **700** of a process of low latency content presentation from the user device **106** point of view. This process may be implemented by the user device **106**.

Block **702** sends, to a server **116**, a request for a piece of content. This request may be for the content to be streamed to the user device **106** and is configured to specify the piece of content for streaming. In some implementations the request may omit the specification of the piece of content, allowing for the server **116** or another device to specify the content which is to be presented. For example, the user **102** may initiate a "random watch" function which allows the server **116** to select the piece of content for presentation.

Block **704**, based at least in part on the request, receives first content from the server **116**. The first content may comprise the unencrypted content **122** based at least in part on the piece of content. For example, the content requested may have been the movie "Burnt Sage" and the unencrypted content **122** may comprise the first ten seconds of that movie.

In another implementation, the first content may be associated with the requested content. For example, the first content may comprise a studio introduction clip for the studio or distribution company of the requested content. Several pieces of content may be associated with the same studio introduction clip, such as various movies made by the same studio. Requests for content associated with the studio may receive first content comprising the studio introduction clip. The same piece of first content may thus be provided to fulfill requests for content which is from that studio or distribution company. Such commonality in the data may be used to reduce the storage requirements of the first content on the server **116**.

In some implementations, the first content provided by the server **116** may be encrypted using techniques which allow for faster presentation compared to the DRM schemes implemented by the DRM modules. For example, the first content may be encrypted using a simple preshared key. Use of the simple preshared key provides some protection of the content, while facilitating rapid presentation. This minimally or simply encrypted content, which is quickly available for presentation, thus may be used to provide the initial presentation, until the fully DRM-protected encrypted content **124** is available for presentation.

Block **706** causes or otherwise begins presentation of the first content on a display device. For example, the processor **402** may send the unencrypted content **122** as processed by the presentation module **108** to the media device interface coupled to the display device. In some implementations the presentation of the second content is synchronized with the presentation of the first content.

Block **708** receives second content comprising encrypted content **124**. The encrypted content **124** may be based at least in part on the piece of content, or may be the content itself. In some implementations the second content may be provided at a higher resolution than the first content. For example, the first content may be provided in 480p standard definition while the second content is provided in 1080p high definition. The action of block **708** may be based at least in part on the request in some implementations.

In some implementations, the first content and the second content may be provided by different servers. These servers may be operated or administered by the same or different entities. For example, the first content may be provided by a first server **116**(**1**) operated by a first content provider, while the second content may be provided by a second server **116**(**2**) operated by a second content provider.

Block **710** decrypts the second content. In some implementations where the content is protected using one or more DRM schemes, the decryption of the second content may use the digital rights management client module **110**. For example, the DRM client module **110** may decrypt the encrypted content **124**. The first content and the second content may be received contemporaneously with one another for a portion of time. For example, the user device **106** may receive two streams simultaneously, one for the unencrypted content **122** and one for the encrypted content **124**. Block **712** causes the discontinuation of the presentation of the first content and causes presentation of the decrypted second content. The discontinuation may include ceasing the sending of the first content to the presentation device. Similarly, the decrypted second content may be sent to the presentation device. For example, the content transition module **112** may transition the presentation on the display from the unencrypted content **122** to the encrypted content **124**. In some implementations, the discontinuation of the first content may occur substantially simultaneously with the presentation of the second content.

The discontinuation and presentation may be synchronized to occur at a predetermined transition time, such as the transition point **210** described above with respect to FIG. **2**, or the transition start **306** and the transition end **308**. As also described above, the predetermined transition time may be fixed, or may vary. The predetermined transition time may vary based at least in part upon availability of the decrypted second content such that the predetermined transition time occurs after the decrypted second content is available.

The process associated with the transition is described in more detail next with regard to FIG. **8**.

FIG. **8** is a flow diagram **800** of a process of transitioning from the unencrypted content **122** to the encrypted content **124** during low latency content presentation. This process may be implemented by the content transition module **112** of the user device **106**.

Block **802** determines a current presentation point in the first content being presented. The current presentation point designates a particular portion of the first content being presented on the display. For example, the current presentation point may indicate that the user device **106** is currently presenting the unencrypted content **122** at time 3.4 seconds. The presentation points or other points within or relative to the content may be based on presentation time, frame number, and so forth.

Block **804** determines the transition point **210** common between the first content and the second content. For example, as described above with regard to FIG. **2**, the transition point **210** may be the point at which the encrypted content **124** is available for presentation.

Block **806**, at a predetermined point in the first content before the transition point **210**, applies the transition effect **418** to the first content before presentation. For example, the content transition module **112** may apply the blur **502** transition effect **418** to the eighteen image frames leading up to the transition point.

In some implementations, the transition effect **418** or another transition effect **418** may be applied to the second content instead of, or in addition to, the first content. Block **808** accesses the second content at a point corresponding to the transition point **210**. Block **810** applies, for a predetermined interval after the transition point **210**, the same transition effect **418** or another transition effect **418** to the second content before presentation. For example, a reverse of the blur **502** transition effect used for the first content may be used to present the second content going from a blurred state to a non-blurred state.

FIG. **9** is a flow diagram **900** of a process of low latency content presentation from the server **116** point of view. This process may be implemented by the content distribution module **118**, the DRM server module **120**, or both.

Block **902** receives a request for a content item from the user device **106**. For example, a request for presentation of the move "Burnt Sage" may be received by the server **116**.

Block **904** determines, based at least in part on the request, first content associated with the requested content item. This first content may comprise unencrypted content or content which is encrypted with simpler or minimal encrypted scheme. For example, the user request for the movie "Burnt Sage" may be processed to determine the particular file identifiers associated with the unencrypted content **122**.

In some implementations the unencrypted content **122** may be generated by decrypting the encrypted content **124** at the server **116**. A predetermined portion of the encrypted content **124** may be decrypted to form the first content, such as the unencrypted content **122**. The predetermined portion may be a predetermined time period of the content from a beginning

of the content. For example, the DRM server module **120** may decrypt the first ten seconds of the encrypted content **124**.

Block **906** determines, based at least in part on the request, second content associated with the requested content item. This second content may comprise encrypted content **124**. For example, the user request for the movie "Burnt Sage" may be processed to determine the particular file identifiers associated with the encrypted content **124**.

Block **908**, based at least in part on the request, sends the first content to the user device **106**. As described above, this first content may comprise the unencrypted content **122**. Alternatively, the first content may be encrypted using a scheme other than DRM which allows for less time to setup and present compared to the DRM scheme.

Block **910** sends second content to the user device **106**. The second content may comprise the encrypted content **124**, which is protected using one or more DRM schemes. For example, the server **116** may use the network interface **608** to send the content over the network **114**. The first content and the second content may be sent to the same user device **106** contemporaneously with one another. As a result, the user device **106** may receive both streams at the same time for at least some period of time.

In some implementations, the action of block **910** may be based at least in part on the request. For example, the initial request for content may be used to trigger the action of block **908** to send the first content as well as the action of block **910** to send the second content.

In some implementations, the server **116** may apply the one or more transition effects **418** to at least a portion of the first content, the second content, or both, before the sending to the user device **106**. For example, the server **116** may modify the stream sent to the user device to impose the blur effect **502** on a portion of the unencrypted content **122** and the encrypted content **124**.

Block **912** discontinues the sending of the first content to the user device **106**. In some implementations, the discontinuation may be based at least in part on the establishment of the DRM privileges and an acknowledgement from the user device **106** that the encrypted content **124** is ready for presentation.

In some implementations where the second content is encrypted or otherwise protected using one or more digital rights schemes, additional blocks may send or exchange one or more keys associated with the one or more DRM schemes associated with the second content. For example, the user device **106** and the server **116** may exchange information such as hardware identifiers and validation codes to determine the user device **106** is authorized to present the encrypted content **124**.

Other implementations may also be used. In one implementation, the server **116** may initiate a single stream to the user device **106**, which starts with unencrypted content **122** and transitions to encrypted content **124**. In this implementation, the user device **106** and the server **116** may engage in the setup of the environment for presentation of the DRM encrypted content **124** while the unencrypted content **122** is transferred for presentation. Upon acknowledgement from the user device **106**, or at a predetermined point, the transferred stream of content may be transitioned from unencrypted to encrypted. As above, the user **102** would thus experience, a seamless transition and may be unaware of the transition.

As described above, the DRM functions and content distribution functions are illustrated on a single server **116**, but it is understood that these functions may be distributed across one or more servers, which may be maintained by one or more different entities. For example, the DRM server module **120** may be maintained on a server operated by a content distributor, while the content distribution module **118** is maintained by a content provider.

The content which these techniques may be applied to include still images, video, associated audio of the video, audio-only and so forth. The processes described above may thus be used to improve the user experience while consuming a wide variety of content.

Those having ordinary skill in the art will readily recognize that certain steps or operations illustrated in the figures above can be eliminated or taken in an alternate order. Moreover, the methods described above may be implemented as one or more software programs for a computer system and are encoded in a computer readable storage medium as instructions executable on one or more processors.

The computer readable storage medium can be any one of an electronic storage medium, a magnetic storage medium, an optical storage medium, a quantum storage medium and so forth. Separate instances of these programs can be executed on or distributed across separate computer systems. Thus, although certain steps have been described as being performed by certain devices, software programs, processes, or entities, this need not be the case and a variety of alternative implementations will be understood by those having ordinary skill in the art.

Additionally, those having ordinary skill in the art readily recognize that the techniques described above can be utilized in a variety of devices, environments and situations.

Although the present disclosure is written with respect to specific embodiments and implementations, various changes and modifications may be suggested to one skilled in the art and it is intended that the present disclosure encompass such changes and modifications that fall within the scope of the appended claims.

What is claimed is:

1. A system, comprising:

a network interface configured to couple to a network;

a media device interface configured to couple to a presentation device;

at least one memory storing computer-executable instructions; and

at least one processor configured to couple to the network interface, couple to the media device interface, access the at least one memory, and execute the computer-executable instructions to:

send, to a server using the network interface, a request for streaming of a piece of content;

based at least in part on the request, receive, using the network interface, a first content stream comprising unencrypted content;

cause presentation of the first content stream using the media device interface;

based at least in part on the request, receive, using the network interface, a second content stream comprising encrypted content, wherein the first content stream and the second content stream are associated with a same content item;

decrypt the received second content stream;

cause the presentation of the first content stream to be discontinued;

cause presentation of the second content stream using the media device interface; and

apply a transition effect to one or more images of at least a portion of one or more of the first content stream or at least a portion of the second content stream before presentation.

2. The system of claim 1, wherein the first content stream has a total length less than that of the second content stream.

3. The system of claim 1, wherein the processor is further configured to execute instructions to receive one or more digital rights management keys, wherein the decrypting comprises decrypting the second content stream using the one or more digital rights management keys.

4. The system of claim 1, wherein the discontinuation of the first content stream occurs substantially simultaneously with the presentation of the second content stream.

5. The system of claim 1, wherein the presentation of the second content stream is synchronized with the presentation of the first content stream.

6. A computer-implemented method for utilizing processing resources of a computerized system, the computer-implemented method comprising:

sending, to a server, a request for streaming a piece of content, the request including information specifying the piece of content;

based at least in part on the request, receiving first content comprising unencrypted content, wherein the unencrypted content is based, at least in part, on the piece of content;

sending the first content to a presentation device;

receiving second content comprising encrypted content, wherein the encrypted content is based, at least in part, on the piece of content;

decrypting the second content;

applying one or more transition effects to one or more images of at least a portion of one or more of the first content or the decrypted second content; and

discontinuing the sending of the first content and sending the decrypted second content to the presentation device.

7. The method of claim 6, wherein the receiving the first content and the receiving the second content are contemporaneous with one another for a portion of time.

8. The method of claim 6, further comprising:

synchronizing the discontinuation of the first content and the presentation of the second content to occur at a transition time.

9. The method of claim 8, wherein the transition time is fixed.

10. The method of claim 8, wherein the transition time varies based at least in part upon availability of the decrypted second content such that the transition time occurs after the decrypted second content is available.

11. The method of claim 6, wherein the causing the discontinuation of the presentation of the first content further comprises:

determining a presentation point in the first content being presented, wherein the presentation point designates a particular portion of the first content being presented;

determining a transition point common between the first content and the second content; and

at a predetermined point in the first content before the transition point, applying the transition effect to the first content before presentation.

12. The method of claim 11, wherein the causing the discontinuation of the presentation of the first content further comprises:

accessing the second content at a point corresponding to the transition point; and

applying, for a predetermined interval after the transition point, the transition effect to the second content before presentation.

13. The method of claim 6, wherein the causing the discontinuation of presentation of the first content further comprises:

accessing the second content at a point corresponding to a transition point, wherein the transition point comprises a point within the second content at which the presentation of the second content occurs; and

applying the transition effect to at least a predetermined portion of the second content before presentation.

14. The method of claim 13, wherein the predetermined portion comprises a predetermined interval starting at the transition point.

15. The method of claim 6, wherein the causing the presentation of the second content further comprises:

determining a presentation point in the first content being presented, wherein the presentation point designates a particular portion of the first content being presented;

determining a transition point common between the first content and the second content; and

at a predetermined point in the first content before the transition point, applying the transition effect to the first content before presentation.

16. The method of claim 11, wherein the causing the presentation of the second content further comprises:

accessing the second content at a point corresponding to the transition point; and

applying, for a predetermined interval after the transition point, the transition effect to the second content before presentation.

17. The method of claim 6, wherein the causing the presentation of the second content further comprises:

accessing the second content at a point corresponding to a transition point, wherein the transition point comprises a point within the second content at which the presentation of the second content occurs; and

applying the transition effect to at least a predetermined portion of the second content before presentation.

18. A computer-implemented method for utilizing processing resources of a computerized system, the computer-implemented method comprising:

receiving, from a user device, a request for a content item;

determining first content associated with the content item, the first content comprising unencrypted content;

determining second content associated with the content item, the second content comprising encrypted content;

based at least in part on the request, sending the first content to the user device;

based at least in part on the request, sending the second content to the user device;

applying with a hardware processor a transition effect to at least a portion of one or more images of one or more of the first content or the second content; and

discontinuing the sending the first content to the user device.

19. The method of claim 18, wherein the sending the first content to the user device and the sending the second content to the user device are contemporaneous with one another.

20. The method of claim 18, wherein the transition effect is applied to at least a portion of the first content before the sending of the first content to the user device.

21. The method of claim 18, further comprising:

decrypting a portion of the second content to form the first content before the sending of the first content to the user device.

22. The method of claim 21, wherein the portion comprises a piece of the second content associated with a time period beginning at a start of the second content.

23. The method of claim 18, further comprising sending or exchanging one or more keys associated with one or more digital rights management schemes associated with the second content.

24. The method of claim 18, wherein the content comprises video and associated audio.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO.	: 9,088,550 B1
APPLICATION NO.	: 13/685252
DATED	: July 21, 2015
INVENTOR(S)	: Quais Taraki et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

On the title page, item (54) and in the specification, column 1, line 1, in the title:

"LOVE" should be --LOW--

Signed and Sealed this
Fifth Day of January, 2016

Michelle K. Lee

Michelle K. Lee
Director of the United States Patent and Trademark Office